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NATIONAL TECHNICAL
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Although the toxic effect of a metal such as chromium on the normal B.O.D. of domestic sewage has been discussed before, sufficient information was desired in order to make a comparison of the oxygen utilization of the sewage without the chromium salts with those of increasing concentrations of chromium salts in terms of p.p.m. of dissolved oxygen depletions.

Since the 5-day B.O.D. of the sewage ranged from 100-300 p.p.m., it was put up at a 1 percent concentration to insure maximum depletion in 5 days without complete exhaustion of the dissolved oxygen. Sodium chromate (Na_2CrO_4) was used for the hexavalent form of chromium, and chromic chloride ($CrCl_3$) for the trivalent form. These solutions of trivalent and hexavalent chromium were added to separate 1 percent sewage samples to give ultimate chromium concentrations of 1, 2, 3, 4, 5, 7.5 and 10.0 p.p.m. The dissolved oxygen content of the sewage samples and of the sewage plus chromium samples was determined before and after the incubation period. From the p.p.m. of dissolved oxygen depletion recorded, the B.O.D. of the samples was calculated.

In the determination of dissolved oxygen in the presence of hexavalent chromium high values are obtained. This is due to the oxidation of the potassium iodide in the final step of the Winkler procedure by the Cr^{+6}. However, under the conditions of the B.O.D. test it is assumed that the same concentration of chromium is present at the end of the five day incubation period as was initially present.

For every p.p.m. of Cr^{+6} present the dissolved oxygen value will be raised by 0.44 p.p.m. In Table 1 the equivalent values of dissolved oxygen per p.p.m. of Cr^{+6} for chromium concentrations from 1 to 10 p.p.m. are given. It will be noted that all of the values are within the experimental error of the dissolved oxygen determination on material of this type.

Tables II and III show all the B.O.D. results including the means for both forms of chromium over the ten experiments. For the trivalent series it will be observed that the lag in B.O.D. increases steadily as the chromium concentration is increased. On the basis of these figures, it can be assumed that additional increases in the Cr^{+3} concentration would produce further increases in the B.O.D. lag.

With the hexavalent chromium, however, a plateau seems to have been reached at 3.0 p.p.m. and further increases in the Cr^{+6} concentration do not alter the leveling of the B.O.D. lag. Figure 1 provides a graphical interpretation of the result noted in Tables II and III.

Table IV is an attempt to compare the two forms of chromium and show the percent of the B.O.D. that can be recovered in their presence. As was observed in Figure 1, the result from this table also indicates that as more trivalent chromium is added, the percent of B.O.D. recovery decreases. In the case of the hexavalent chromium, the slope of the line shows that the percent of B.O.D. recovered is not altered appreciably as the concentration of chromium is increased.

SUMMARY

(1) The toxicity of both hexavalent and trivalent chromium has been observed in this experiment.

(2) Although both forms of chromium induced a B.O.D. lag with 1.0 p.p.m. concentration, the trivalent form showed the more consistent inhibition as the chromium concentration was increased.

(3) The hexavalent chromium reached a plateau in its effect on the B.O.D. of sewage when its concentration was 3.0 p.p.m., and further increases to 10 p.p.m. had no significant effect on the inhibition.

Table I

Experiment No.	p.p.m. Cr^{+6} Added						
	1	2	3	4	5	7.5	10.0
	D.O. Equivalent Fouhd/p.p.m. Cr^{+6}						
1	.39	.44	.40	.37	.40	.41	.41
2	.42	.41	.40	.43	.42	.40	.41
3	.44	.36	.39	.38	.37	-	.36
4	.32	.39	.39	.39	.36	.40	.35
5	.44	.42	.48	.42	.42	.46	.43
6	.49	.48	.45	.43	.45	.46	.44
7	.40	.40	.42	.43	.39	.42	.41
8	.52	.48	.43	.47	.43	.44	.45
Mean	.43	.42	.42	.42	.41	.43	.41

1 p.p.m. of Cr^{+6} is equivalent to 0.44 p.p.m. of D.O.

Table II

Effect of Trivalent Chromium on the B.O.D. of Sewage

Conc. of Cr^{+3}	0.0	1.0	2.0	3.0	4.0	5.0	7.5	10.0
1	326	337	289	253	201	208	123	97
2	294	266	229	168	162	133	101	80
3	58	50	32	31	30	34	28	21
4	233	224	194	165	149	118	99	83
5	226	195	159	133	108	102	78	73
6	187	139	121	115	102	79	54	43
7	137	56	31	23	16	38	41	33
8	90	65	56	48	47	43	33	33
9	254	212	152	145	123	125	89	85
10	254	199	154	138	120	110	91	86
Mean	206	173	142	122	106	99	74	63

Table III

Effect of Hexavalent Chromium on the B.O.D. of Sewage

Conc. of Cr^{+6}	0.0	1.0	2.0	3.0	4.0	5.0	7.5	10.0
1	153	99	101	92	91	93	96	51
2	58	52	51	59	50	53	64	58
3	110	98	101	114	109	113	98	133
4	226	189	176	163	172	169	170	170
5	187	135	147	116	84	132	113	88
6	137	97	90	86	84	31	39	26
7	90	72	57	60	41	49	-	30
8	125	138	137	124	99	-	94	127
9	254	222	223	221	228	207	189	202
10	254	199	189	174	189	182	163	147
Mean	159	130	127	121	115	114	114	103

Table IV

Percent B.O.D. Recovered in Presence of Chromium

p.p.m. Chromium Added	Percent B.O.D. Recovered	
	$Chromium^{+3}$	$Chromium^{+6}$
1	84.0	81.6
2	69.0	80.0
3	59.3	76.2
4	51.7	72.3
5	48.1	71.7
7.5	36.0	71.7
10	31.0	65.0

FIGURE 1

EFFECT OF TRI AND HEXAVALENT CHROMIUM

ON THE B.O.D. OF DOMESTIC SEWAGE